Lab 4

1 importing the required dependancies

In [43]:

```
import numpy    as np
import pandas   as pd
import seaborn  as sns

import pickle
import matplotlib.pyplot as plt

from sklearn.preprocessing    import StandardScaler
from sklearn.preprocessing    import RobustScaler
from sklearn.preprocessing    import MinMaxScaler
from sklearn.model_selection  import train_test_split
from sklearn.metrics          import accuracy_score
from sklearn.metrics          import classification_report
from sklearn.metrics          import confusion_matrix

from sklearn.decomposition  import PCA
```

2 reading the files into a dataframe

In [44]:

```
train = pd.read_csv('/content/trainT.csv')
```

3 displaying the first 5 lines and shape of the dataset

In [45]:

```
display(train.head())
print(train.shape)
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

```
(891, 12)
```

4 taking few columns of train to make a new dataframe

In [46]:

```
df = train[['Survived', 'Pclass', 'Sex', 'Age', 'Fare']]
```

In [47]:

In [47]:

```
df.head()
```

Out[47]:

	Survived	Pclass	Sex	Age	Fare
0	0	3	male	22.0	7.2500
1	1	1	female	38.0	71.2833
2	1	3	female	26.0	7.9250
3	1	1	female	35.0	53.1000
4	0	3	male	35.0	8.0500

In [48]:

```
df['Sex'].value_counts()
```

Out[48]:

```
male      577
female    314
Name: Sex, dtype: int64
```

5 Label Encoding for the 'Sex' column ie converting the male to 0 and female to 1

In [49]:

```
df['Sex'] = df['Sex'].apply(lambda sex:1 if sex=='male' else 0)

#Alternate approaches to label encoding
# df['Sex'] = df['Sex'].map({'male':0, 'female':1})
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_gu
ide/indexing.html#returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
```

In [50]:

```
df.head()
```

Out[50]:

	Survived	Pclass	Sex	Age	Fare
0	0	3	1	22.0	7.2500
1	1	1	0	38.0	71.2833
2	1	3	0	26.0	7.9250
3	1	1	0	35.0	53.1000
4	0	3	1	35.0	8.0500

6 Checking the number of NA's present in the dataset

In [51]:

```
print("Checking the NA's in the dataframe")
display(df.isna().sum())
print("\nInfo of the datset\n")
display(df.info())
```

```
Checking the NA's in the dataframe
```

```
Survived      0
Pclass        0
Sex           0
Age         177
Fare          0
dtype: int64
```

```
Info of the datset
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 5 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   Survived  891 non-null    int64
 1   Pclass    891 non-null    int64
 2   Sex       891 non-null    int64
 3   Age       714 non-null    float64
 4   Fare      891 non-null    float64
dtypes: float64(2), int64(3)
memory usage: 34.9 KB
```

```
None
```

7 Filling the NA values with the median of the column

In [52]:

```
df['Age'] = df['Age'].fillna(df['Age'].fillna(df['Age'].median()))
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_gu
ide/indexing.html#returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
```

In [53]:

```
#verifying the fillna function
df['Age'].isna().sum()
```

Out[53]:

```
0
```

8 Splitting the dataset into target and instance values

In [54]:

```
X = df.drop('Survived', axis=1)
y = df['Survived']
```

9 Splitting the dataset into train and test

In [55]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0)
```

In [56]:

```
#using the help function to get the parameters and the other details about the train_test_
split
help(train_test_split)
```

```
Help on function train_test_split in module sklearn.model_selection._split:
```

```
train_test_split(*arrays, **options)
    Split arrays or matrices into random train and test subsets

    Quick utility that wraps input validation and
    ``next(ShuffleSplit().split(X, y))`` and application to input data
    into a single call for splitting (and optionally subsampling) data in a
    oneliner.

    Read more in the :ref:`User Guide <cross_validation>`.

    Parameters
    ----------
    *arrays : sequence of indexables with same length / shape[0]
        Allowed inputs are lists, numpy arrays, scipy-sparse
        matrices or pandas dataframes.

    test_size : float, int or None, optional (default=None)
        If float, should be between 0.0 and 1.0 and represent the proportion
        of the dataset to include in the test split. If int, represents the
        absolute number of test samples. If None, the value is set to the
        complement of the train size. If ``train_size`` is also None, it will
        be set to 0.25.

    train_size : float, int, or None, (default=None)
        If float, should be between 0.0 and 1.0 and represent the
        proportion of the dataset to include in the train split. If
        int, represents the absolute number of train samples. If None,
        the value is automatically set to the complement of the test size.

    random_state : int, RandomState instance or None, optional (default=None)
        If int, random_state is the seed used by the random number generator;
        If RandomState instance, random_state is the random number generator;
        If None, the random number generator is the RandomState instance used
        by `np.random`.

    shuffle : boolean, optional (default=True)
        Whether or not to shuffle the data before splitting. If shuffle=False
        then stratify must be None.

    stratify : array-like or None (default=None)
        If not None, data is split in a stratified fashion, using this as
        the class labels.

    Returns
    -------
    splitting : list, length=2 * len(arrays)
        List containing train-test split of inputs.

        .. versionadded:: 0.16
            If the input is sparse, the output will be a
            ``scipy.sparse.csr_matrix``. Else, output type is the same as the
            input type.

    Examples
    --------
    >>> import numpy as np
    >>> from sklearn.model_selection import train_test_split
    >>> X, y = np.arange(10).reshape((5, 2)), range(5)
    >>> X
    array([[0, 1],
           [2, 3],
           [4, 5],
           [6, 7],
           [8, 9]])
    >>> list(y)
    [0, 1, 2, 3, 4]

    >>> X_train, X_test, y_train, y_test = train_test_split(
    ...     X, y, test_size=0.33, random_state=42)
    ...
    >>> X_train
    array([[4, 5],
```

```
           [0, 1],
           [6, 7]])
    >>> y_train
    [2, 0, 3]
    >>> X_test
    array([[2, 3],
           [8, 9]])
    >>> y_test
    [1, 4]

    >>> train_test_split(y, shuffle=False)
    [[0, 1, 2], [3, 4]]
```

10 Generating accuracy score, classification report, confusion matrix.

In [78]:

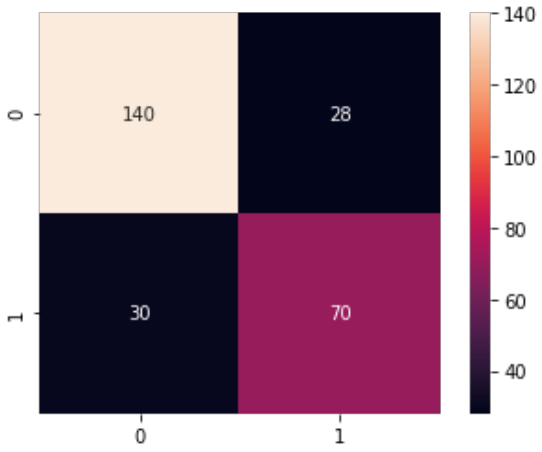
```
def get_accuracy_metrics(y_test, y_hat):

  #Generating accuracy score
  print("\nAccuracy attained : {}\n".format(accuracy_score(y_hat,y_test)))

  #Getting the classification matrix
  print("The classification report is :\n\n{}".format(classification_report(y_test, y_hat
)))

  #Confusion matrix
  # print("Confusion matrix generated"confusion_matrix(y_test, y_hat))
  print("\n")
  sns.heatmap(confusion_matrix(y_test, y_hat),annot=True,fmt='g', square=True)

def plot_accuracies(y_hat,model=''):
  x,accs=[],[]
  max_x,max_acc = 0,0

  #iterating through various values of threshold possible ie 0-100
  for i in range(0,105,5):

    x.append(i)
    z=[]

    #checking if the probability is greater than threshold for each y_hat predicted
    for row in y_hat*100:
      if max(row)>i:
        z.append(np.argmax(row))
      else :
        z.append(np.argmin(row))

    #Generating a list for accuracy scores
    accs.append(accuracy_score(z,y_test))

    if accuracy_score(z,y_test) >= max_acc :
      max_acc = accuracy_score(z,y_test)
      max_x = i
    else :
      continue

  #Plotting function
  plt.figure(figsize=(10,5))
  plt.plot(x,accs)
  plt.axvline(x=max_x,label='Maximum accuracy at x = {}, value is {}'.format(max_x, max_a
cc), color='red')
  plt.title("Accuracies of various thresholds of {}".format(model))
  plt.xlabel("Value of threshold")
  plt.ylabel("Accuracy")
  plt.legend()

  return accs,x
```

Logistic Regression

In [79]:

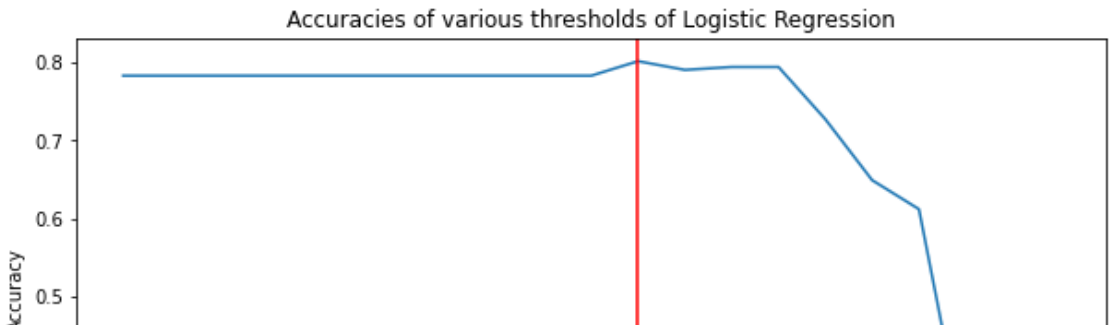
```
from sklearn.linear_model import LogisticRegression

#making logistic regression variable
logit = LogisticRegression(random_state=0)

#fitting the model
logit.fit(X_train,y_train)

print(logit.get_params()) #to get the parameters of the model
# print(logit.coef_)

#making predictions
get_accuracy_metrics(y_test, logit.predict(X_test))
```

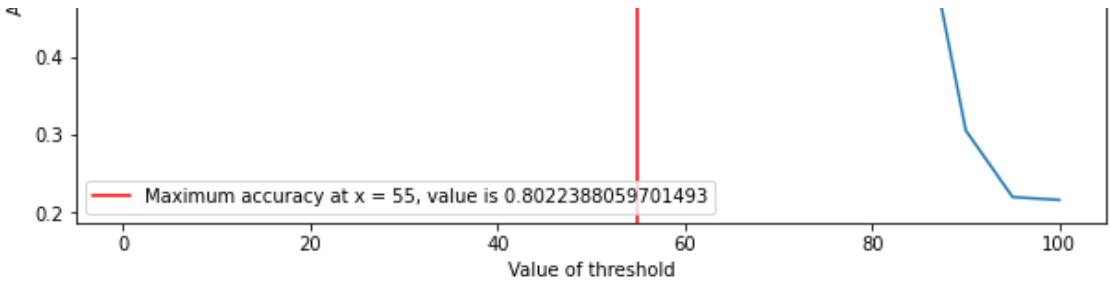
```
{'C': 1.0, 'class_weight': None, 'dual': False, 'fit_intercept': True, 'intercept_scaling'
: 1, 'l1_ratio': None, 'max_iter': 100, 'multi_class': 'auto', 'n_jobs': None, 'penalty':
'l2', 'random_state': 0, 'solver': 'lbfgs', 'tol': 0.0001, 'verbose': 0, 'warm_start': Fal
se}

Accuracy attained : 0.7835820895522388

The classification report is :

              precision    recall  f1-score   support

           0       0.82      0.83      0.83       168
           1       0.71      0.70      0.71       100

    accuracy                           0.78       268
   macro avg       0.77      0.77      0.77       268
weighted avg       0.78      0.78      0.78       268
```



In [80]:

```
#getting probability predictions so as to apply threshold of the partition to get better c
lassifier
y_hat = logit.predict_proba(X_test)
acscs_logit,x_logit = plot_accuracies(y_hat, 'Logistic Regression')
```





11 Naive Bayes model for classification

In [60]:

```
from sklearn.naive_bayes import GaussianNB
gnb = GaussianNB()
gnb.fit(X_train, y_train)
```

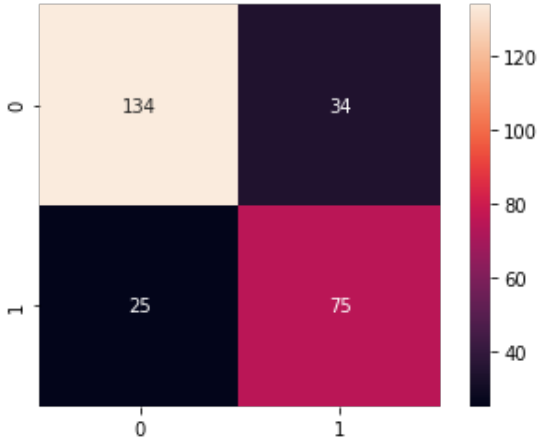
Out[60]:

```
GaussianNB(priors=None, var_smoothing=1e-09)
```

In [61]:

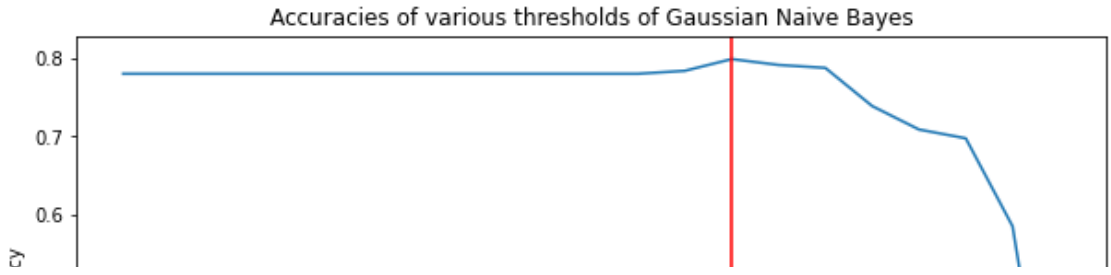
```
get_accuracy_metrics(y_test, gnb.predict(X_test))
```

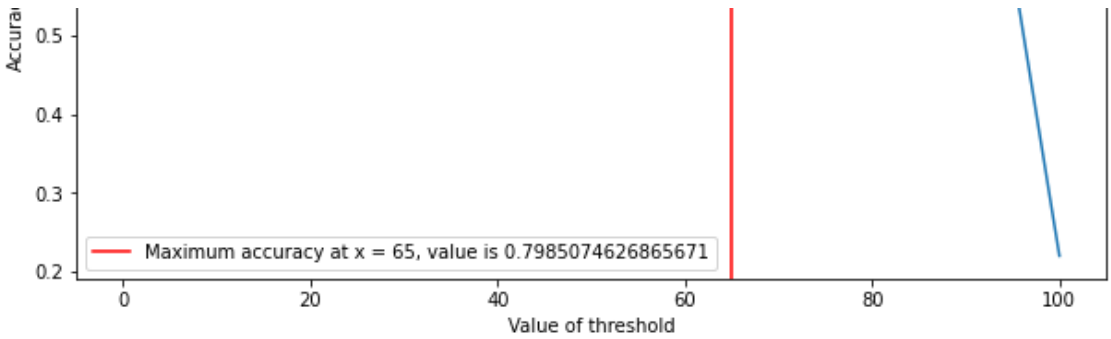
```
Accuracy attained : 0.7798507462686567

The classification report is :

              precision    recall  f1-score   support

           0       0.84      0.80      0.82       168
           1       0.69      0.75      0.72       100

    accuracy                           0.78       268
   macro avg       0.77      0.77      0.77       268
weighted avg       0.79      0.78      0.78       268
```



In [62]:

```
y_hat = gnb.predict_proba(X_test)
acscs_nb, x_nb = plot_accuracies(y_hat,'Gaussian Naive Bayes')
```





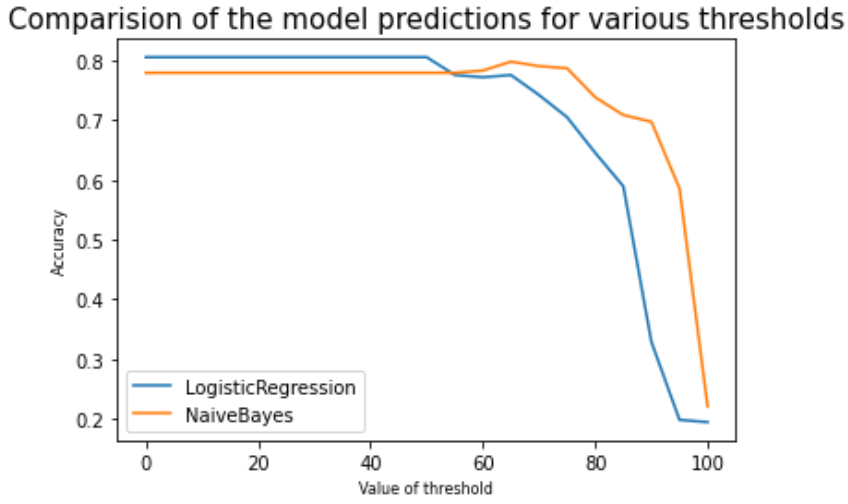
12 Comparision b/w models

In [63]:

```
def plotter(model_names, accs, x):
  i=0
  for acc in accs:
    plt.plot(x, acc, label= model_names[i])
    i+=1
  plt.title("Comparision of the model predictions for various thresholds",fontdict={'fontsize':15})
  plt.xlabel("Value of threshold",fontdict={'fontsize':8})
  plt.ylabel("Accuracy",fontdict={'fontsize':8})
  plt.legend()
```

In [64]:

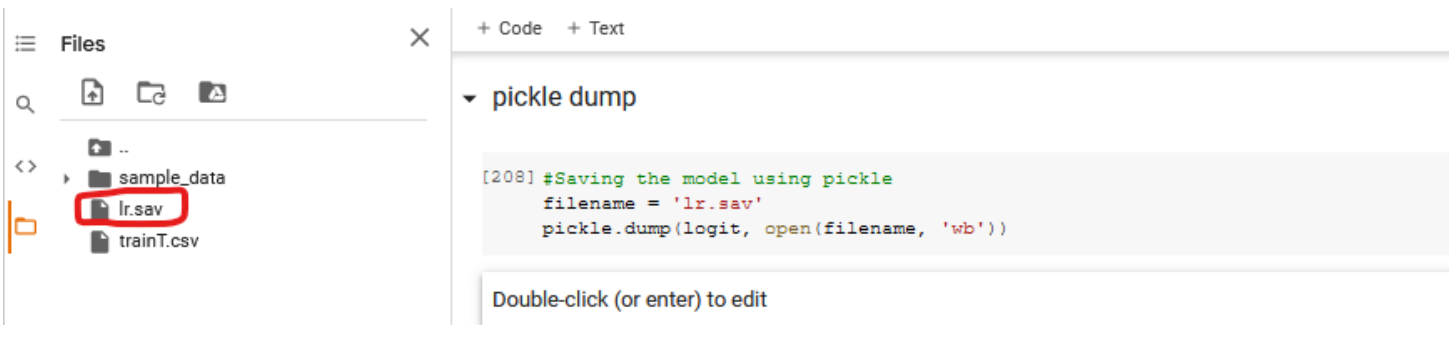
```
model_names = ['LogisticRegression', 'NaiveBayes']
accs = [acscs_logit ,acscs_nb]
plotter(model_names,accs, x_nb)
```



13 Pickle dump for saving the model

In [65]:

```
#Saving the model using pickle
filename = 'lr.sav'
pickle.dump(logit, open(filename, 'wb'))
```

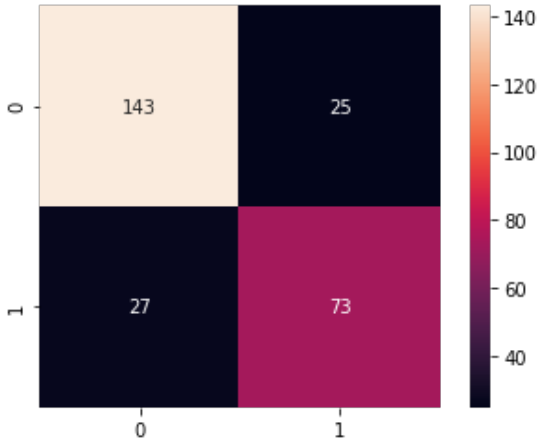


The saved model is shown in the files section

In [66]:

```
# Sanity check after oading the model back from pickle
logit = pickle.load(open(filename, 'rb'))
get_accuracy_metrics(y_test, logit.predict(X_test))
```

```
Accuracy attained : 0.8059701492537313

The classification report is :

              precision    recall  f1-score   support

           0       0.84      0.85      0.85       168
           1       0.74      0.73      0.74       100

    accuracy                           0.81       268
   macro avg       0.79      0.79      0.79       268
weighted avg       0.81      0.81      0.81       268
```



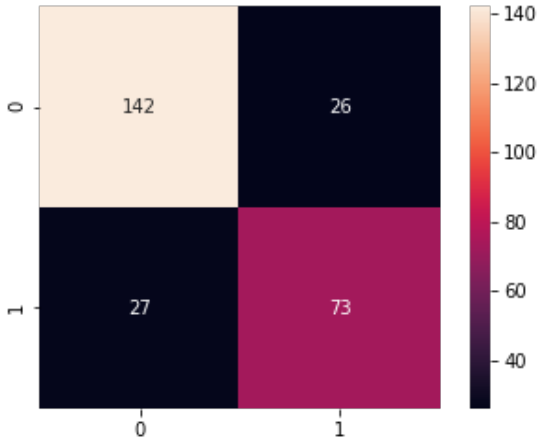
14 Classification after scaling the data

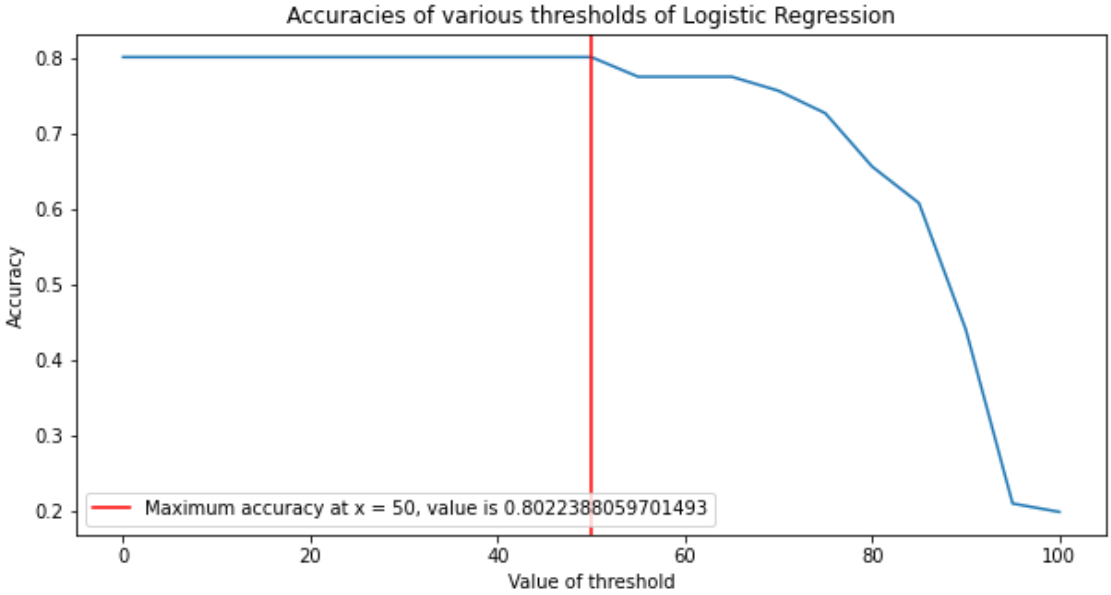
Logistic Regression

In [67]:

```
X = df.drop('Survived', axis=1)
X = StandardScaler().fit_transform(X)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0)

logit = LogisticRegression(random_state=0)
logit.fit(X_train,y_train)
get_accuracy_metrics(y_test, logit.predict(X_test))
y_hat = logit.predict_proba(X_test)
acscs_logit,x_logit = plot_accuracies(y_hat, 'Logistic Regression')
```

```
Accuracy attained : 0.8022388059701493

The classification report is :

              precision    recall  f1-score   support

           0       0.84      0.85      0.84       168
           1       0.74      0.73      0.73       100

    accuracy                           0.80       268
   macro avg       0.79      0.79      0.79       268
weighted avg       0.80      0.80      0.80       268
```

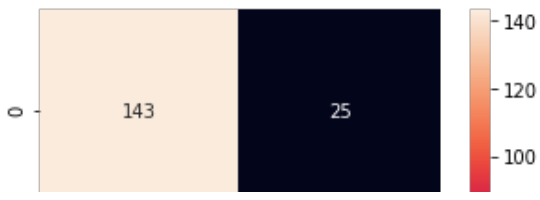


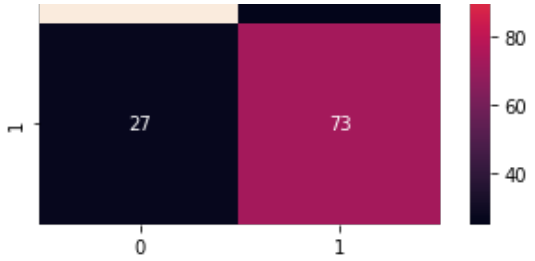


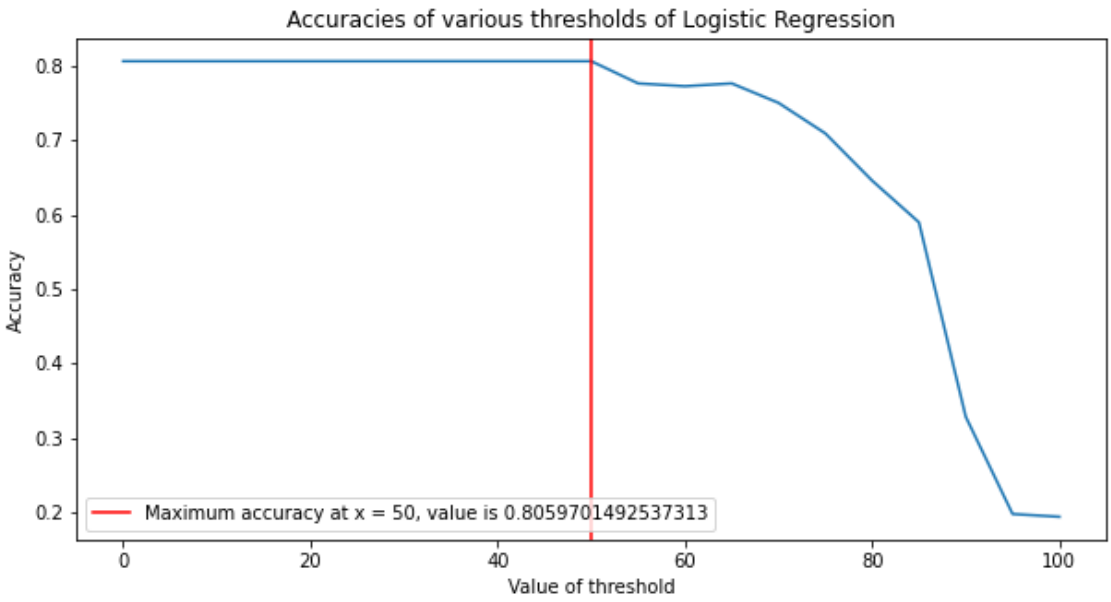
In [68]:

```
X = df.drop('Survived', axis=1)
X = RobustScaler().fit_transform(X)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0)

logit = LogisticRegression(random_state=0)
logit.fit(X_train,y_train)
get_accuracy_metrics(y_test, logit.predict(X_test))
y_hat = logit.predict_proba(X_test)
acscs_logit,x_logit = plot_accuracies(y_hat, 'Logistic Regression')
```

```
Accuracy attained : 0.8059701492537313

The classification report is :

              precision    recall  f1-score   support

           0       0.84      0.85      0.85       168
           1       0.74      0.73      0.74       100

    accuracy                           0.81       268
   macro avg       0.79      0.79      0.79       268
weighted avg       0.81      0.81      0.81       268
```



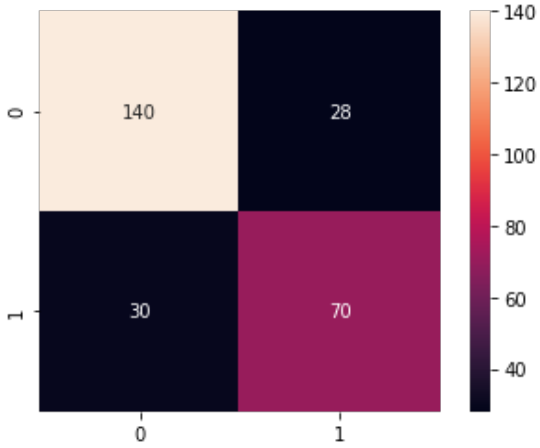


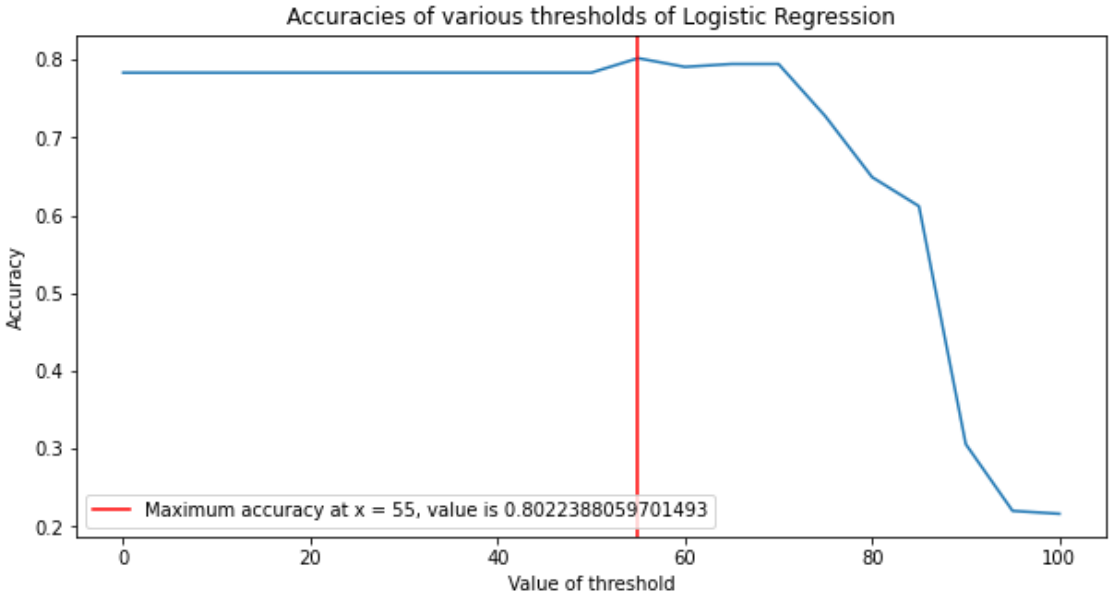


In [69]:

```
X = df.drop('Survived', axis=1)
X = MinMaxScaler().fit_transform(X)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0)

logit = LogisticRegression(random_state=0)
logit.fit(X_train,y_train)
get_accuracy_metrics(y_test, logit.predict(X_test))
y_hat = logit.predict_proba(X_test)
acscs_logit,x_logit = plot_accuracies(y_hat, 'Logistic Regression')
```

```
Accuracy attained : 0.7835820895522388

The classification report is :

              precision    recall  f1-score   support

           0       0.82      0.83      0.83       168
           1       0.71      0.70      0.71       100

    accuracy                           0.78       268
   macro avg       0.77      0.77      0.77       268
weighted avg       0.78      0.78      0.78       268
```





Gaussian Naive Bayes

In [ ]:

```
X = df.drop('Survived', axis=1)
X = StandardScaler().fit_transform(X)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0)

gnb = GaussianNB()
gnb.fit(X_train,y_train)
get_accuracy_metrics(y_test, gnb.predict(X_test))
y_hat = gnb.predict_proba(X_test)
acscs_logit,x_logit = plot_accuracies(y_hat, 'Naive Bayes')
```

In [ ]:

```
X = df.drop('Survived', axis=1)
X = RobustScaler().fit_transform(X)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0)

gnb = GaussianNB()
gnb.fit(X_train,y_train)
get_accuracy_metrics(y_test, gnb.predict(X_test))
y_hat = gnb.predict_proba(X_test)
acscs_logit,x_logit = plot_accuracies(y_hat, 'Naive Bayes')
```

In [ ]:

```
X = df.drop('Survived', axis=1)
X = MinMaxScaler().fit_transform(X)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0)

gnb = GaussianNB()
gnb.fit(X_train,y_train)
get_accuracy_metrics(y_test, gnb.predict(X_test))
y_hat = gnb.predict_proba(X_test)
acscs_logit,x_logit = plot_accuracies(y_hat, 'Naive Bayes')
```

15 PCA

In [25]:

```
X = StandardScaler().fit_transform(X)
pca = PCA(n_components=2)
principalComponents = pca.fit_transform(X)
```

In [26]:

```
principalDf = pd.DataFrame(data = principalComponents
             , columns = ['principal component 1', 'principal component 2'])
```

In [27]:

```
finalDf = pd.concat([principalDf, df[['Survived']]], axis = 1)
```

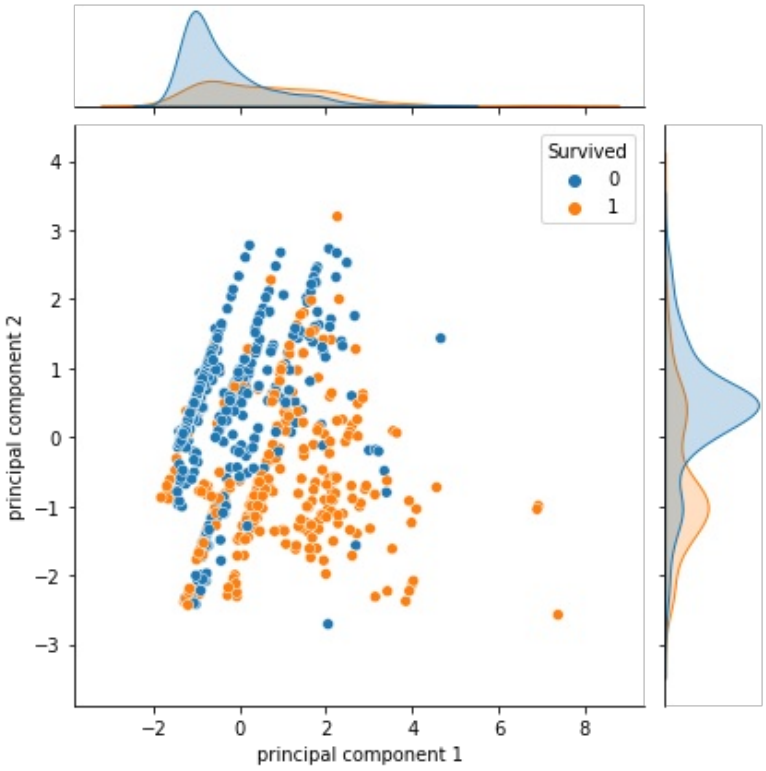
In [28]:

```
sns.jointplot(finalDf['principal component 1'], finalDf['principal component 2'], hue=fina
lDf['Survived'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the
following variables as keyword args: x, y. From version 0.12, the only valid positional ar
gument will be `data`, and passing other arguments without an explicit keyword will result
in an error or misinterpretation.
  FutureWarning
```

Out[28]:

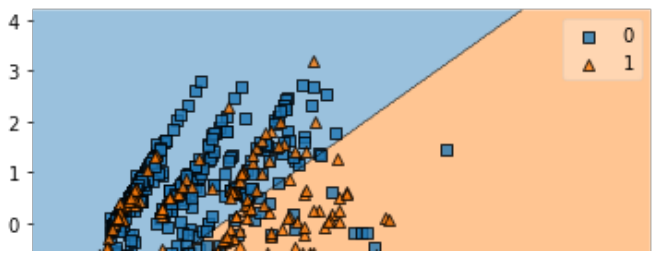
```
<seaborn.axisgrid.JointGrid at 0x7fbcb98550d0>
```

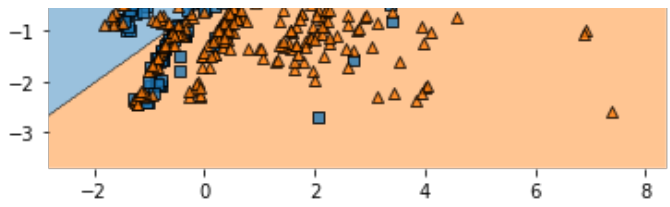


In [31]:

```
from sklearn.svm import SVC
import matplotlib.pyplot as plt
from mlxtend.plotting import plot_decision_regions

logit.fit(finalDf.drop(['Survived'],axis=1).values, finalDf['Survived'].values)
plot_decision_regions(finalDf.drop(['Survived'],axis=1).values, finalDf['Survived'].value
s, clf=logit)
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/mlxtend/plotting/decision_regions.py:244: Matplotli
bDeprecationWarning: Passing unsupported keyword arguments to axis() will raise a TypeErro
r in 3.3.
  ax.axis(xmin=xx.min(), xmax=xx.max(), y_min=yy.min(), y_max=yy.max())
```





In [31]:

```

```

In [ ]:

```

```